

Health Consultation

City of Montesano – Whitney’s Chevrolet, Inc.
Montesano, Grays Harbor County, Washington

November 24, 2010

Prepared by

**The Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry**



Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

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For more information about ATSDR, contact the ATSDR Information Center at 1-888-422-8737 or visit the agency's Web site: www.atsdr.cdc.gov/.

Glossary

Acute	Occurring over a short time [compare with chronic].
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Aquifer	An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.
Cancer Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a <i>comparison value</i> used to select contaminants of potential health concern and is based on the <i>cancer slope factor</i> (CSF).
Carcinogen	Any substance that causes cancer.
Chronic	Occurring over a long time (more than 1 year) [compare with acute].
Comparison value (CV)	Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.
Contaminant	A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
Dermal Contact	Contact with (touching) the skin (see route of exposure).
Dose (for chemicals that are not radioactive)	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental Media Evaluation Guide (EMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a <i>comparison value</i> used to select contaminants of potential health concern and is based on ATSDR's <i>minimal risk level</i> (MRL).
Environmental Protection Agency (EPA)	United States Environmental Protection Agency.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].
Groundwater	Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
Lowest Observed Adverse Effect Level (LOAEL)	The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal Risk Level (MRL)	An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see oral reference dose].
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
Monitoring wells	Special wells drilled at locations on or off a hazardous waste site so water can be sampled at selected depths and studied to determine the movement of groundwater and the amount, distribution, and type of contaminant.
No Observed Adverse Effect Level (NOAEL)	The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

Oral Reference Dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides that are not easily dissolved in water.
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Plume	A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.
Reference Dose Media Evaluation Guide (RMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The RMEG is a <i>comparison value</i> used to select contaminants of potential health concern and is based on EPA's oral reference dose (RfD).
Remedial investigation	The process of determining the type and extent of hazardous material contamination at a site.
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Surface Water	Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].
Volatile organic compound (VOC)	Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

SUMMARY

INTRODUCTION

The Washington Department of Health (DOH) conducted this health consultation at the request of the Washington Department of Ecology (Ecology). The focus of this health consultation is on the indoor air health threat posed by evaporating subsurface contaminants associated with the Whitney's Chevrolet Inc. (Whitney's Chevrolet) site located in downtown Montesano. When contaminants evaporate from soil or groundwater, they can travel through the soil and enter overlying buildings through cracks or other openings in the foundation. This is known as vapor intrusion. In communities where contaminated sites like the Whitney's Chevrolet site are located, DOH's job is to ensure that the community has the best information possible about the potential health threat posed by these sites.

CONCLUSION 1

DOH is unable to conclude whether breathing the air in existing buildings that overlie, or are adjacent to, the subsurface contamination at the Whitney's Chevrolet site, currently, or in the future, poses a health threat. Additional site characterization is necessary for the health department to reach a conclusion. However, based on the available indoor air data from some tested buildings at the site, it appears that the health threat to building occupants and customers is low.

BASIS FOR DECISION

The nature and extent of the soil, soil gas, groundwater, and indoor air contamination associated with the Whitney's Chevrolet site is not fully understood. However, data is available to help us begin to understand the potential health threat.

CONCLUSION 2

Contaminated soil, soil gas, and groundwater may pose an indoor air health threat to building occupants if new construction occurs in the area in the future and steps are not taken to address the vapor intrusion pathway (e.g., installation of a soil vapor vacuum system during construction).

BASIS FOR DECISION

Buildings constructed in locations where subsurface contaminants pose an indoor air health threat are at risk for vapor intrusion if steps (e.g., installation of a soil vapor vacuum system during construction) are not taken to cutoff the pathway during construction.

NEXT STEPS

- Additional site characterization is planned for the future.
- The City of Montesano planning department will be notified within 30 days of the release of the final health consultation report that soil, soil gas, and groundwater may pose an indoor air health threat to future building occupants if new construction occurs in the area and

steps are not taken to address the site contamination.

- Ecology will ensure that the health department's recommendations are fully considered in the preparation of the final approved remedial investigation report and future site work.
- Ecology will ensure that DOH receives future investigation plans and reports for the site and will consider the health department's recommendations. If there is disagreement or lack of understanding about DOH's recommendations, Ecology will meet with DOH to resolve these issues before Ecology approves the plans or reports.
- DOH will provide copies of this health consultation report to Ecology, Grays Harbor County, City of Montesano including the City of Montesano Planning Department, Whitney's Chevrolet, and three businesses located on the site (Sterling Savings Bank, Charlie's Bar, and VFW).
- DOH will post this health consultation report on its web site to make it available to the general public.
- DOH will review future investigation plans and reports that fill the data gaps if requested by Ecology.

**FOR MORE
INFORMATION**

If you have health concerns about the Whitney's Chevrolet site, please contact Barbara Trejo, Washington Department of Health, at 1-877-486-7316.

Purpose and Statement of Issues

The Washington Department of Health (DOH) conducted this health consultation at the request of the Washington Department of Ecology (Ecology). The focus of this health consultation is on the indoor air health threat posed by evaporating subsurface contaminants associated with the Whitney's Chevrolet site, located in downtown Montesano. It is a follow-up to a health consultation completed by DOH in April 2009.(1) DOH conducts health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste.

Past releases of petroleum (predominantly gasoline) at the Whitney's Chevrolet site have resulted in contaminated soil and groundwater underlying a portion of downtown Montesano, Grays Harbor County, Washington. Lead and non-petroleum related volatile organic compounds (VOCs) (predominantly the solvent tetrachloroethylene (PCE)) have also been found in groundwater.(2) Ecology reports that the PCE originates from the Whitney's Chevrolet facility (comment from Marv Coleman, Ecology, to Barbara Trejo, DOH, August 26, 2010). When found in soil and shallow groundwater, volatile chemicals, like gasoline and solvents, evaporate. Those vapors (also known as soil gas) move through the air spaces between the soil particles and can enter overlying buildings through cracks and other openings in the foundations. This is known as vapor intrusion. If indoor vapor concentrations are high enough, they can pose a health threat.

Businesses in downtown Montesano get their drinking water from the City of Montesano. This drinking water is not affected by the contamination from the Whitney's Chevrolet site. Although businesses are not drinking the contaminated groundwater, environmental studies conducted by Whitney's Chevrolet, which are being monitored by Ecology, suggest that some gasoline components found at the site, such as benzene and ethylene dichloride (EDC), are evaporating and moving up through the soil and entering indoor air.(2)

Background

The main Whitney's Chevrolet facility is located at 123 West Pioneer Avenue. A Whitney's Chevrolet repair shop is also located directly north and across from the main facility on West Pioneer Avenue. Gasoline sales and automobile sales and repairs have occurred at the property from about 1914.(3) Gasoline sales were discontinued in 1995. Current on-site repair activities include mechanical and auto body repairs.(2)

Six underground storage tanks (USTs) associated with the Whitney's Chevrolet operation are located south of West Pioneer Avenue. The USTs were used to store gasoline, waste solvents, waste oil, and fuel oil for the heating system. Three of the USTs are located along South Main Street. These three reportedly contained gasoline and were closed in-place in August 1995. Three additional USTs are located below the main Whitney's Chevrolet building.(2) It appears that these three USTs are still being used. It is unknown whether Whitney's Chevrolet has USTs at its repair shop north of West Pioneer Avenue. However, Ecology reports that they will be asking Whitney's Chevrolet to provide information about possible USTs at the repair shop as

part of the remedial investigation (RI) (response from Scott Rose, Ecology, to Barbara Trejo, DOH, August 27, 2010).

The Whitney's Chevrolet site currently includes Whitney's Chevrolet and three adjacent businesses to the east (Sterling Savings Bank, Charlie's Bar, and Veterans of Foreign Wars #2455 (VFW)). Additionally, portions of Tony's Short Stop Texaco (Tony's Short Stop) and portions of City of Montesano streets (South First Street, South Main Street, and West Pioneer Avenue) are part of the site. Except for some small landscaped areas, the entire site is covered with buildings, concrete, or asphalt.(2)

Whitney's Chevrolet is one of three sites in a three block area of downtown Montesano where USTs exist, or were used in the past, and appear to be the current source of soil and groundwater contamination in the area. The other two sites are Tony's Short Stop, located to the southeast of Whitney's Chevrolet, and Brumfield Twidwell, about a block to the east. Recent information from Ecology (May 20, 2010 discussion with Marv Coleman), indicates that other gasoline stations may have existed in the three block area in the past. Current information suggests that the Whitney's Chevrolet groundwater plume has co-mingled with the petroleum contaminated groundwater at Tony's Short Stop.(2)

A number of underground utilities are located in an alley between Whitney's Chevrolet and the three businesses to the east. These include water, power, gas, storm sewer, and sanitary sewer lines. It is reported that the storm sewer is the deepest utility with a depth of about 12 feet below ground surface (bgs) and that other utilities might be located as deep as 10 feet bgs. Information included in the 2010 draft RI report suggests that the backfill for the utilities is granular. Additionally, a water line runs along South First Street, directly west of Whitney's Chevrolet. Well graded gravel approximately 9 feet thick was reportedly used as backfill along that water line. A city storm sewer is located about 9 feet below South Main Street. The backfill for that storm sewer line also appears to be granular and is 10 feet thick. Side utility connection locations for only the Whitney's Chevrolet, Sterling Savings Bank, Charlie's Bar, and VFW properties were included in the draft RI report.(2) However, no information was provided about the side connection backfill type, so it is uncertain whether it is granular.

The Whitney's Chevrolet building has a slab-on-grade foundation.(4) The slab thickness is reported to be 4 inches and has expansion joints and various cracks. Offices, salesroom, and repair shop that includes automobile maintenance and painting, are located in the building.(2)

The Sterling Savings Bank has an unfinished, concrete basement in the western third of the building. The remaining two-thirds of that building contain a slab-on-grade foundation. The basement contains some cracks, which have reportedly been filled. It is also reported that the bank basement is mainly used for storage. Banking operations occur on the main floor.(2) The Sterling Savings Bank reports that the basement does not have any characteristic that would result in vapor entry, such as utility conduits, portions of wall missing or exposed soils.(5) However, a complaint about petroleum odors was made in the early 1990s when the building was occupied by Key Bank.(6) Ecology reports that they responded soon after the complaint was filed and had the floor of the basement sealed. The odor was eliminated at the time and has not been reported to have recurred (comment from Scott Rose, Ecology, to Barbara Trejo, August 18, 2010).

Charlie's Bar and VFW occupy the same building, which is a two-story structure. Charlie's Bar, which is located in the northern portion of the building, has a basement in the western third of the building, which is used for storage. It is reported that the basement has "concrete walls and soil". The remaining two-thirds of Charlie's Bar are underlain by a crawlspace that is partially covered with plastic.(2) The building owners/occupants report that the basement does have utility conduits. The VFW portion of the building is underlain by a crawlspace. The crawlspace at that part of the building is reportedly covered with plastic.(7) Apartments are located on the second floor of this building and were reported as unoccupied during the RI.(2)

Geology/Hydrogeology

Soils in the area are comprised mostly of unconsolidated to partly consolidated alluvial deposits, consisting of sand and gravels with lenses of clay and silt up to 20 feet thick. The alluvial deposits are reportedly underlain by a relatively impermeable silt or clay unit of unknown thickness. Regional groundwater flow is to the south-southeast toward the Chehalis River with the water table reportedly occurring approximately 3 to 15 feet bgs.(2;8)

Some boring logs provided by Ecology for Whitney's Chevrolet, Tony's Short Stop, and nearby Pederson and Montesano Farm and Home properties (copies sent by Dom Reale, December 24, 2008), as well as boring logs generated during the 2008-2010 RI work, provide more information about subsurface conditions, which are important to understand when evaluating the vapor intrusion pathway.(2) The well logs indicate that sands, silty sands, and sandy/silty gravels (native and fill) lie directly below the ground surface. The depths of these soils vary across the investigation areas. In many cases, it appears that these upper soils are underlain by a clay or silt unit. The clay/silt unit thickness varies across the area and is absent in some areas particularly at utility locations.(2) Some wet soils appear to exist over the clay/silt unit suggesting localized perched groundwater conditions. The extent of such perched zones cannot be determined. Moist to wet sands or gravels with some silty sand layers underlie the clay/silt unit. This is the unit where the monitoring well screens have been placed suggesting this is the first aquifer. In some cases, the borings have penetrated the sands and gravels and encountered dense, silty sands.

It is reported that a laterally continuous, unconfined, shallow aquifer exists across the site. The water table is about 13 to 16.5 feet bgs at the Whitney's Chevrolet property, depending on location and season. The lowest water levels occurred in the summer months, dropping about 2 feet below winter levels. Groundwater flows southeast across the site, but becomes more easterly near South Main Street.(2)

Environmental Investigations

Whitney's Chevrolet and Ecology have conducted a number of soil and groundwater investigations at the site. The data collected during those investigations indicate that releases of petroleum and non-petroleum VOCs have occurred to soil and groundwater at the main Whitney's Chevrolet property and that the contamination extends beyond the property boundaries.(9;10) Some of the USTs and associated equipment, and possible surface releases, appear to be the source of the contamination associated with this portion of the property.(2)

Ecology reports that no investigation has occurred on the Whitney's Chevrolet repair shop property located north of West Pioneer Avenue (comments from Scott Rose, Ecology, to Barbara Trejo, DOH, August 18, 2010).

The earliest reported investigation by Whitney's Chevrolet occurred in 1995 in the northwestern portion of the main property, south of West Pioneer Avenue. At that time, three USTs were reportedly decommissioned and soils were tested. Gasoline (and associated chemicals: benzene, ethylbenzene, toluene, and xylenes (BTEX)), were found in soils above Model Toxics Control Act (MTCA) cleanup levels.¹ No groundwater was encountered during that investigation, so the impact on groundwater at that time is unknown.(2)

In 2004, Ecology began an area-wide investigation in downtown Montesano because of a number of known and suspected petroleum contaminated sites in the area. The study area encompassed several blocks, primarily from West Pioneer Avenue south along Main Street. In 2005, Ecology conducted further investigations, including the use of ground penetrating radar to locate remaining USTs at Whitney's Chevrolet and the former Brumfield-Twidwell property. Based on these investigations, and subsequent work conducted through 2009, three properties were identified as sources of petroleum contamination (predominantly gasoline and related components) in soil and/or groundwater in downtown Montesano: Tony's Short Stop, Whitney's Chevrolet, and Brumfield-Twidwell. Solvents were also found in groundwater in some areas. The highest concentrations of gasoline and associated compounds Ecology detected in groundwater were from monitoring wells at Tony's Short Stop. Gasoline and benzene, for example, reached levels as high as 490,000 micrograms per liter ($\mu\text{g/l}$) and 28,300 $\mu\text{g/l}$, respectively, in 2007. Gasoline and benzene levels at the Whitney's Chevrolet site reached as high as 74,000 $\mu\text{g/l}$ and 850 $\mu\text{g/l}$, respectively, in 2007.(2;3) Additionally, free-phase petroleum was observed in some wells at the source areas.(11)

Whitney's Chevrolet began additional investigation work (i.e., RI) regarding the releases associated with its property in 2007. That work continued periodically from 2008 through 2010, and included testing soil, groundwater, soil gas, and indoor and outdoor air at Whitney's Chevrolet and nearby properties. A phased approach was used. The initial RI focused on source identification and additional characterization of soil and groundwater at the Whitney's Chevrolet property. The second phase (i.e., supplemental RI) focused on assessing potential off-property sources and utility locations. It also included further characterization (nature and extent) of soil and groundwater contamination at Whitney's Chevrolet and adjacent properties. Additionally, soil gas and indoor and outdoor air testing was conducted at and near Whitney's Chevrolet, Sterling Savings Bank, Charlie's Bar, and the VFW.(2)

The initial and supplemental RI results are provided in a *Draft Remedial Investigation Report*, dated March 24, 2010. The report indicates that the Whitney's Chevrolet property is the likely source of the petroleum contamination found in soil and groundwater at the site. Some non-petroleum volatile compounds were also found in groundwater, particularly PCE. As noted previously, Ecology reports that the PCE originates from the Whitney's Chevrolet facility. The report also indicates that the contamination associated with the Whitney's Chevrolet property has

¹ The Model Toxics Control Act is the hazardous waste cleanup law for Washington State.

moved beyond the property boundaries and underlies nearby properties (Sterling Savings Bank, Charlie's Bar, VFW, a portion of Tony's Short Stop, and a portion of City of Montezano streets). Whitney's Chevrolet is also the likely source of much of the contamination found in soil gas at the site. However, soil gas along the eastern portion of the site may also be affected by the petroleum contamination associated with the nearby Tony's Short Stop site.(2) The upcoming RI planned for the Tony's Short Stop site will help to refine our understanding.

Ecology petroleum methods (NWTPH) were used to analyze for gasoline, diesel, and oil in soil and groundwater. EPA Method 8260B was used to analyze for petroleum and non-petroleum related VOCs in soil, soil gas, and groundwater while indoor and outdoor air were analyzed using EPA Method TO-15 or TO-15 SIM. No petroleum fraction analysis was conducted for either air or soil gas.² The TO-15 analyte list differs somewhat from the Method 8260B list, which resulted in some inconsistent analysis between the media. Data gaps may exist as a result of the lack of fractionated petroleum vapor data. However, the indoor air collected from the tested buildings does include analysis for 63 volatile compounds, including benzene.

The laboratory analytical sheets, which include quality assurance/quality control (QA/QC) analyses, were included in the RI report. Cover letters included with those analytical data sheets suggest that some of the 2008 soil data may underestimate the actual contaminant concentrations because samples were not preserved appropriately (e.g., some soil petroleum samples were not preserved with methanol). Some soil samples were analyzed outside the holding times. Additionally, some of the surrogate recoveries for gasoline and ethylene dibromide (EDB) samples in 2008 were very low suggesting that some soil and groundwater contaminant levels may be underestimated.

Cover letters and analytical data sheets were also reviewed for the 2009 and 2010 sampling events. It was noted that for some of the indoor air samples the reported levels for ethanol (a gasoline component) exceeded the instrumentation calibration range.(2) This could result in an underestimation of indoor air levels. However, ethanol is a common indoor air contaminant because of its presence in products such as alcohol and hand sanitizers, so this may not be a significant issue. Additionally soil gas samples, which were collected using syringes and polyethylene tubing, had holding times that an Air Toxics Ltd. paper indicates likely results in significant losses of volatile compounds. The use of polyethylene tubing also makes the soil gas sample results questionable because the tubing can increase the frequency and concentration of artifacts and also result in low recoveries of volatile components of concern.(2;12;13)

Soil Results

The highest concentrations of petroleum related compounds in soils were generally found below the 4-foot depth near the Whitney's Chevrolet USTs during the initial direct push technology (DPT) investigation. Up to 16,000 mg/kg of gasoline and 16,000 mg/kg oil range petroleum was found below the Whitney's Chevrolet building near the USTs while up to 1,700 mg/kg of

² Petroleum fraction analysis is required under the MTCA cleanup regulation for the purpose of calculating air cleanup levels. Please note that additional RI work is needed and that cleanup levels have not yet been established for the site.

gasoline was found near the former USTs location along South First Street. BTEX, naphthalenes, and other petroleum compounds were also elevated above detection limits. The draft RI report indicates the presence of a smear zone near the USTs, which when exposed during the drier summer and fall months, can contribute contaminants to soil gas. Low levels of some non-petroleum related compounds (e.g., acetone, 2-butanone) were also found below the 4-foot depth at the Whitney's Chevrolet property.

Gasoline, oil, BTEX, naphthalene, and other petroleum components were found at much lower concentrations in soil at similar locations to the DPT borings at the Whitney property during the initial RI monitoring well installation. This could be attributed to sampling variability or possible sampling issues (see discussion above about 2008 soil samples preservation and analytical issues).

Little soil contamination was found near Sterling Savings Bank, Charlie's Bar, or the VFW properties.(2)

It was noted that some of the soil detection limits for benzene and methyl t-butyl ether (MTBE), both components of gasoline and chemicals of potential concern for this site, exceed the MTCA screening levels included in the draft RI report. However, these results were reported as non-detects. This approach could result in an underestimation of the extent of the soil contamination.

The majority of the lateral and vertical extent of the soil contamination on the Whitney's property has been determined. Soil impacts appear to be limited to the northern portion of the Whitney's Chevrolet facility, beneath the on-site building and the right-of-way at the northwestern corner of the property. Data gaps do exist within this right-of-way and it is unknown how much further contamination extends beneath South First Street. These data gaps are expected to be addressed as part of either the final RI, or during interim cleanup actions consisting of UST and impacted soil removals (comment from Scott Rose, Ecology, to Barbara Trejo, DOH, August 18, 2010).

Groundwater Results

Groundwater samples were collected from temporary DPT well screens and monitoring wells installed during the initial and supplemental RI. No free phase petroleum was reportedly found floating on the groundwater at the Whitney's Chevrolet site during the RI. Additionally, no diesel or oil was found dissolved in groundwater. However, high levels of dissolved gasoline were found in groundwater across the site.(2)

The highest level of gasoline found in groundwater during the initial RI was obtained at DPT-5 (78,000 µg/l) on the Whitney's Chevrolet property in April 2008. BTEX, other benzene compounds, ethylene dibromide (EDB), naphthalene, and PCE were also detected. The highest level of benzene found at Whitney's Chevrolet in 2008 was 2,500 µg/l. High levels of gasoline (up to 74,000 µg/l) and benzene (up to 1,900 µg/l) were also found in April 2008 in shallow groundwater along South First Street and in the vicinity of utility lines located in the alley east of Whitney's Chevrolet and near Charlie's Bar and VFW.(3) The highest level of PCE found in April 2008 was 62 µg/l between two of the abandoned UST locations along South First Street.

High levels of gasoline (up to 43,100 µg/l), benzene (up to 836 µg/l), naphthalenes (up to 1,600 µg/l), and other petroleum related compounds were found during the supplemental RI in the vicinity of Charlie's Bar and the VFW and extended under South Main Street. High levels of gasoline and gasoline-related compounds continued to be found at the Whitney's Chevrolet property. High levels of naphthalenes (up to 114 µg/l) were also found near the Whitney Repair Shop (DPT-44 and DPT-45, which appear to be located hydraulically side-gradient of the Repair Shop property), located north of West Pioneer Avenue. PCE was found across the site with the highest level (41.9 µg/l) found below the Whitney's Chevrolet building in January 2010. The second highest PCE level (34.1 µg/l) found in January 2010 was between the three USTs on the eastside of South First Street.(2)

The DPT well screens were generally 3 feet long while the monitoring wells were constructed with 15-foot screens. It is unclear why 15-foot screens were used because groundwater reportedly only fluctuates about 2 feet throughout the year (see draft RI Table 12).(2) The depths of all the groundwater samples are not recorded in the RI report, so it is unknown whether the DPT and monitoring well samples were collected at the same depth. However, given the higher concentrations found in some of the DPT wells versus the lower concentrations associated with some nearby monitoring wells, it is possible that samples collected from the monitoring wells represent different parts of the aquifer or may have been diluted.

There is no information provided in the draft RI report about sample preservation, so it is unknown whether samples were preserved appropriately. Additionally, the wells (temporary and permanent) were purged and sampled using a peristaltic pump or submersible pump.(2) It should be noted that a peristaltic pump is typically not the appropriate pump when sampling for VOCs because it can cause volatilization resulting in an underestimation of the contaminant levels in groundwater. However, given the magnitude of VOC concentrations identified in groundwater beneath the site (particularly benzene, up to 1,900 µg/l), the loss of volatiles is not likely to be significant enough in areas where high levels of contaminants exist to either conclude that groundwater impacts do not exist or prevent an evaluation of potential impacts to indoor air. In areas where low levels of contaminants exist, the loss of volatiles could be significant. Also of note, submersible pumps, which are water cooled when run at low flows, can cause heating of the sample and loss of VOCs. This can typically be averted by closely monitoring temperature, which is one of the water quality parameters monitored during the low-flow sampling process, and adjusting the flow rates.

It is important to note that while impacts to groundwater below the northern portion of the Whitney's Chevrolet property have been well characterized, neither the lateral nor vertical extent of the groundwater contamination across the site has been fully defined. Draft RI report Figures 26 and 27, for example, indicate that the gasoline plume is not defined to the west (see WCMW-1, WCMW-2, and WCMW-5), northwest (see ESMW-1), and south (see KBMW-7). Figures 28 and 29 and Figures 30 and 31 indicate that the benzene and PCE plumes, respectively, are similarly undefined.(2) Plume maps were not created for other contaminants (e.g., naphthalenes). As noted previously, groundwater flows southeast across the site, but becomes more easterly near South Main Street.(2) While further characterization is warranted, the source of the contamination appears to be from the USTs or other releases at the Whitney's Chevrolet

facility. However, the Whitney's repair shop may also be an additional source of contamination. As noted earlier, current information suggests that the Whitney's Chevrolet groundwater plume has co-mingled with the petroleum contaminated groundwater at Tony's Short Stop.(2) Ecology reports that full characterization of this area will be required as part of the Tony' Short Stop site RI (comments from Dom Reale, Ecology to Barbara Trejo, DOH, August 18, 2010).

Soil Gas Results

Photo-ionization detector (PID) results were obtained during the DPT and monitoring well installations (measured in parts per million (ppm)). The PID was calibrated using isobutylene.(14;14;15) These results are qualitative but help us understand the possible impacts to soil gas below the site.

The PID results indicate that significant levels of soil gas contamination exist across the site (e.g., 1,640 ppm at 13 feet bgs on KBMW-9 and 3,125 ppm at 16 feet bgs at DPT-2). Some locations had elevated PID readings in the shallow subsurface (above the clay unit). DPT-35 to DPT-37, for example, had PID readings ranging from 0.2 to 1.6 ppm at 2 feet bgs. PID readings taken at KBMW-9, located along South Main Street near the sanitary sewer lines, indicate a PID reading of 273 ppm at approximately 4.5 to 6 feet bgs. KBMW-8 and KBMW-10 also had elevated PID readings at the same depth (3.2 ppm and 2.2 ppm, respectively).

Grab soil gas samples were collected at 8 feet bgs during the supplemental RI and were analyzed for petroleum and non-petroleum- related compounds using Environmental Protection Agency (EPA) Method 8260.(2) The samples were collected using syringes and polyethylene tubing but had holding times that Air Toxics Ltd., a California air analytical laboratory, indicates will likely result in significant losses of volatile compounds. Air Toxics also indicates that polyethylene tubing can affect the results. (2;12;13) Additionally, none of the soil gas samples were tested for petroleum fractions, which could be a significant portion of the soil gas contamination associated with this site. Consequently, the soil gas data collected to date has limited use when determining the nature and extent of the soil gas contamination. However, the soil gas data that was obtained as part of the Whitney's Chevrolet RI work did indicate petroleum constituents and other VOCs in the soil vapor across the site indicating a potential for impacts to indoor air. In anticipation of these results, Ecology reports that they preemptively required sampling of indoor air as part of the RI (comment from Scott Rose, Ecology, to Barbara Trejo, DOH, August 18, 2010).

BTEX, naphthalenes, other petroleum related compounds, and PCE were detected in soil gas across the site, which indicates that the site contaminants are evaporating from soil and groundwater and moving into the soil column posing a potential vapor intrusion threat to overlying buildings. The highest detected level of benzene in soil gas (93 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)) was found just west of the former Whitney's Chevrolet USTs located along South First Street and east of the Post Office building. PCE was detected at the highest level (210 $\mu\text{g}/\text{m}^3$) at the northwest corner of the intersection of West Pioneer Avenue and South First Street. Some of the other non-petroleum related compounds, such as TCE, had elevated detection limits, so these compounds may also be present. Additionally, naphthalene, benzenes, and xylenes were found in soil gas at two locations directly south of the Whitney's Chevrolet repair facility (DPT-44 and DPT-45).(2)

It should be noted that no soil gas testing occurred in the utility backfills during the RI. These backfills are granular and a possible migration pathway for vapors. Soil gas sampling did, however, occur adjacent to utility corridors at some direct push locations where less granular soils exist (e.g., DPT-39, DPT-40, DPT-47, and DPT-48). However, these results may not be representative of the levels found in the utility trenches because they were collected in fine-grained clayey soils.

Air Results

Indoor air samples were collected at Whitney's Chevrolet, Sterling Savings Bank, Charlie's Bar, and the VFW. Each indoor air sampling location was tested for 63 chemicals. Samples were collected for 8-hours using SUMMA canisters. Indoor and outdoor air samples were analyzed using TO-15 or TO-15 selected ion mode (SIM), which is a different analytical method than was done for soil gas (EPA Method 8260). Consequently, some of the tested indoor air analytes are different than those tested in soil gas. Like the soil gas results, indoor and outdoor air samples were analyzed for some petroleum and non-petroleum related compounds, but none of the air samples were tested for petroleum fractions.

Twenty-seven of the 63 tested chemicals were found above reporting limits in one or more of the indoor air samples, including gasoline-related compounds (e.g., benzene, ethylbenzene, naphthalene, ethanol, hexane, heptane, ethylene dichloride), and non-gasoline compounds (e.g., acetone; 1,4-dichlorobenzene). Table 1 summarizes the range of indoor air results for each building and also includes the range of outdoor air results that were obtained during the same time period as the indoor air results. Outdoor air samples were collected near each building.

Whitney's Chevrolet Screening Level Evaluation

MTCA Method A and B cleanup levels were used by Whitney's Chevrolet to identify chemicals of potential concern (COPC) for soil and groundwater. However, these cleanup levels were not developed to protect the indoor air pathway. Consequently, some of the chemicals screened out by Whitney's Chevrolet might pose an unacceptable indoor air health risk.

Community Health Concerns

Except for a complaint about petroleum odors at the former Key Bank location (now Sterling Savings Bank) in the 1990s, no community health concerns have been reported. However, Ecology and DOH (since it became involved with the site in 2009) have been actively working to educate stakeholders (e.g., City of Montesano, Grays Harbor County Health, businesses, and the community) about the contamination and what it might mean to them.

Discussion

Petroleum (predominantly gasoline and some lube oil) and some non-petroleum VOCs (predominantly PCE) are the chemicals that appear to have been released to soil and groundwater by the Whitney's Chevrolet facility. These chemicals pose a potential health threat to workers

and customers at, and near, the Whitney's Chevrolet site who are breathing in these chemicals via the vapor intrusion pathway. Several factors will determine whether harmful health effects might occur. These factors include the dose (how much), the duration (how long), the route or pathway of exposure (breathing), other chemical exposures, and individual characteristics such as age, sex, overall health, genetics, and lifestyle.

Gasoline

Gasoline is a complex man-made mixture that is produced from petroleum refining. Gasoline is predominantly in the C₄-C₁₂ hydrocarbon range.(16) Typically, gasoline contains more than 150 chemicals, including small amounts of BTEX, although as many as 1,000 chemicals have been identified in some blends. How the gasoline is made determines which chemicals are present in the mixture and how much of each is present.(17) A table showing the major components of gasoline is included in Appendix A. It is important to note that when gasoline is released into the environment physical, chemical, and/or biological processes can degrade the chemical components. As a result, gasoline found in soil or groundwater often will have a different composition than what was originally released.

Anti-knock agents, antioxidants, metal deactivators, lead scavengers, anti-rust agents, anti-icing agents, lubricants, detergents, and dyes may also be added to gasoline, including chemicals like MTBE, ethanol (ethyl alcohol), methanol (methyl alcohol), tetramethyl-lead, tetraethyl-lead, ethylene dichloride (EDC), and ethylene dibromide (EDB).(18)

A number of the chemicals found in gasoline, including some of the additives, are volatile and can easily evaporate into the air.

PCE

PCE is a man-made chlorinated solvent that has been widely used in dry cleaning operations and for metal degreasing. When released under certain environmental conditions, physical, chemical, and/or biological processes can degrade PCE into TCE, vinyl chloride, and other chlorinated compounds. PCE, and its breakdown products, can easily evaporate into the air.(19)

Health Assessment

When evaluating the indoor air health threat posed by the subsurface contaminants (i.e., soil, groundwater, and soil gas), it is important to understand the nature and extent of volatile contaminants in the subsurface as well as the levels found in indoor and outdoor air. As noted in the Environmental Investigations section above, there were some issues with the sampling and analytical methods used during the Whitney's Chevrolet RI that could result in an underestimation of the nature and extent of contamination in soil, soil gas, groundwater, and/or air at the site. This limits our ability to evaluate the vapor intrusion pathway. ***As a result, the data collected to date cannot be used to make a full health determination for the site.***

However, the data do suggest that the vapor intrusion pathway is likely a completed exposure pathway and that gasoline contaminated soil, soil gas, and groundwater appear to be affecting indoor air at the Sterling Savings Bank, VFW, and Charlie's Bar because some of the indoor air contaminant levels (benzene and EDC) exceed outdoor air levels and are found in the crawlspaces/basements at levels higher than indoor air levels. These two conditions suggest that

the subsurface is the source of these chemicals.

Table 1 provides the range of indoor air results from each tested building and the range of outdoor air results. Other buildings located west of South First Street (e.g., Post Office), north of West Pioneer Avenue (e.g., office building east of Whitney's Chevrolet Repair Shop), and east of South Main Street (e.g., building that contains Montesano Liquor and Wine and other businesses) may also be affected, but have not been tested. Table 2 summarizes the chemicals found in indoor air, soil gas, and groundwater and also indicates those chemicals that were not tested in the various media. However, as noted previously, there were some potential issues with the soil gas and groundwater sampling protocols and analysis, so Table 2 may not reflect all the possible site contaminants in these media.

DOH has used the available limited indoor and outdoor air data (it is lacking the petroleum fraction data) to identify whether this subset of chemicals pose a possible inhalation health concern to workers and customers at Whitney's Chevrolet, Sterling Savings Bank, VFW, and Charlie's Bar.

Chemicals of Possible Inhalation Health Concern

DOH compared the range of each of the 27 chemicals detected in indoor air to published health comparison values (Appendix B) and outdoor air levels to identify chemicals that might be associated with the subsurface contamination and of possible health concern (Table 3). Additionally, if the chemicals in air were tested but not detected at a location (i.e., below the reporting limit), DOH used one half the reporting limit when doing the assessment. Normally, DOH would only use half of the reporting limit for those chemicals that were found in air and also found groundwater, soil, or soil gas. However, because of the sampling problems and uncertainty about the levels of these chemicals found in the different media, DOH elected to use this more conservative approach.

The published health comparison values (Appendix B) are set at levels much lower than levels that might cause people to get sick. This is done to be protective of the most sensitive individuals (i.e., children and older adults), as well as to account for our lack of certainty regarding the health effects from exposure to low levels of chemical exposure. When there is evidence that a chemical might cause cancer, the lowest comparison value corresponds to a theoretical cancer risk increase of one additional cancer in a population of one million people for a continuously exposed individual over a lifetime. Although this level of risk is not considered to be a health concern, decisions about cleanup of contamination are often made to reduce risks below this level when possible.

The health comparison values used during the evaluation included ATSDR air screening levels (environmental media evaluation guides (EMEGs) and cancer risk evaluation guides (CREGs)), U.S. Environmental Protection Agency (EPA) regional screening levels or reference doses for chemical contaminants at Superfund sites, and Washington State Model Toxics Control Act (MTCA) air cleanup levels. In some cases, no health comparison level was available.

When the highest level for each chemical at each location was less than the health comparison value, no further evaluation of that chemical was necessary because DOH does not consider the chemical to be of health concern. However, there were some chemicals at the tested buildings with levels above the health comparison values, including benzene; 1,3-butadiene; ethylbenzene; EDB; EDC; naphthalene; 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 1,4-dichlorobenzene; methylene chloride; PCE; trichloroethylene (TCE); and vinyl chloride (Table 3). It is important to understand that a contaminant level above a health comparison value does not mean that people will get sick if they are exposed to that contaminant. However, the more a level exceeds a health comparison value and approaches a level where we would expect people to get sick, the more concern we have. The chemicals that exceeded the screening values were further evaluated to determine if the levels would be expected to harm people's health. Additionally, there were some chemicals that had no health comparison levels. These chemicals were also carried forward for further evaluation and are highlighted in Table 3.

Levels of Chemicals That Could Harm People's Health

To further assess those chemicals of health concern (i.e., where the levels are greater than the health comparison values or where no health comparison value exists), DOH reviewed the available toxicological literature for these 17 chemicals. This information helps us determine if contaminant levels would be expected to harm people's health. Contaminant levels that would be expected to harm people's health are referred to as "health threshold" levels. Health threshold levels are determined by studying humans or animals that have been exposed to high levels of a chemical, such as might occur in an occupational (i.e., workplace) setting or in a laboratory study of exposed animals.

Health threshold levels used in this step included levels such as "no observed adverse effect levels" (NOAELs), "lowest observed adverse effect levels" (LOAELs), and "lowest published toxic dose" (TCLo). A LOAEL is the lowest tested dose of a chemical that has been reported to cause harmful health effects in people or animals. A NOAEL is the highest tested dose of a chemical that has been reported to have no harmful health effects on people or animals. A TCLo is similar to a LOAEL. Cancer effect levels (CELs) were used for carcinogenic compounds. DOH conservatively selected the lowest inhalation threshold levels for each chemical in this step.

LOAELs, NOAELs, TCLos, or CELs were only available for 12 of the 17 chemicals carried forward for further evaluation. These chemicals and their associated health threshold levels are provided in Table 4 along with the maximum levels of each of those chemicals detected in indoor air in the four buildings. As noted in the table, none of these 12 chemicals exceeded the health threshold levels.

No LOAELs, NOAELs, TCLos, or CELs were found for 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; and 2,2,4-trimethylpentane, ethanol, or heptane. Some limited information was available regarding the health threat posed by ethanol and heptane:

- Ethanol - California's Office of Environmental Health Hazard Assessments (OEHHA) released an updated draft report in February 15, 2000 titled *Potential Health Risks of*

Ethanol in Gasoline. The report notes that there is no evidence of ethanol carcinogenicity by inhalation and developed a 100,000 $\mu\text{g}/\text{m}^3$ non-carcinogenic health protective concentration for one hour and annual average exposures. This draft health protective concentration includes an uncertainty factor of 10 to account for inter-individual variability within the human population, including potentially sensitive human subpopulations (e.g., infants).(20) This health protective number is more than 20 times higher than the levels found in indoor air at the Whitney's Chevrolet, Sterling Savings Bank, Charlie's Bar, and the VFW.

- Heptane - Maine has a 4,000 $\mu\text{g}/\text{m}^3$ interim ambient air guideline for heptane.(21;22) The Maine air guideline is more than 110 times greater than the levels found in the four tested buildings.(21;22)

No reliable health related information was available for 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; and 2,2,4-trimethylpentane, so the health threat could not be evaluated.

It is important to note, that while the chemicals evaluated in this step might be below levels that would be expected to harm people's health (e.g. LOAEL), they still can pose some increased individual or total theoretical health risk. DOH has not calculated those risks as part of this health assessment because of the limitations associated with the data.

Construction and Utility Worker Exposure to Contaminated Soil Gas

Although the focus of this health consultation is on the vapor intrusion pathway, it is important to note that utility and construction workers could be exposed to contaminants in soil gas vapors when digging or working in contaminated subsurface soils on private or public properties (e.g., utility trenches, excavations). According to Ecology, utilities and the city planning department are already aware of this situation and have been taking appropriate steps to protect their workers during subsurface work in the area (comment from Scott Rose, Ecology, to Barbara Trejo, DOH, August 18, 2010).

Children's Health Considerations

Children can be uniquely vulnerable to the hazardous effects of environmental contaminants, like petroleum and solvents, when found in indoor air. When compared to adults, pound for pound of body weight, children breathe more air. This fact leads to an increased exposure to contaminants. Additionally, the fetus is highly sensitive to many chemicals, particularly with respect to potential impacts on childhood development.

The Whitney's Chevrolet site is located in a commercial area in downtown Monteseano. DOH expects that children will only have minimal exposure to indoor air contaminants at the four tested buildings. However, child exposures were considered when selecting the possible chemicals of concern for this health consultation.

Conclusions

1. DOH is unable to conclude whether breathing the air in existing buildings that overlie, or are adjacent to, the subsurface contamination at the Whitney's Chevrolet site, currently, or in the future, poses a health threat. Additional site characterization is necessary for the health department to reach a conclusion. However, based on the available indoor air data from some tested buildings, it appears that the health threat to building occupants and customers is low.
2. Contaminated soil, soil gas, and groundwater may pose an indoor air health threat to future building occupants if new construction occurs in the area and steps are not taken to address the vapor intrusion pathway (e.g., installation of a soil vapor vacuum system during construction).

Recommendations

1. Additional site characterization is needed to determine the nature and extent of contamination at the site and the indoor air health threat posed by the contaminated soil and groundwater at Whitney's Chevrolet, Sterling Savings Bank, Charlie's Bar, and the VFW. Whether the site poses a health threat to other buildings within and adjacent to the plume boundary, which is currently undefined, also needs to be determined. This would include, for example, buildings located west of South First Street (e.g., Post Office), north of West Pioneer Avenue (e.g., office building east of Whitney's Chevrolet Repair Shop), and east of South Main Street (e.g., building that contains Montesano Liquor and Wine and other businesses).

DOH believes the additional work needed includes, but is not limited to the following:

- Expanding the map showing utility locations and connections across and along both sides of West Pioneer Avenue, South Main Street, and South First Street
- Conducting a quality assurance/quality control (QA/QC) assessment of the existing data and presenting the findings in the final RI report
- Developing cross sections that show the nature and extent of the various individual contaminants in soil, soil gas, and groundwater, including PID readings obtained during drilling
- Investigating the nature and extent of contamination associated with the Whitney's Chevrolet repair shop located north of West Pioneer Avenue
- Installing and sampling permanent soil gas probes across the site, including utility trenches and below building slabs
- Sampling groundwater and soil to better define the nature and extent of contamination and developing additional maps that illustrate the lateral and vertical extent of contamination
- Installing additional permanent monitoring wells to better understand the extent of the plume
- Conducting additional indoor and outdoor air testing to better understand how contaminated soil and groundwater might be affecting indoor air quality at nearby businesses

- Investigating the source and extent of the PCE plume (and potential associated breakdown products).

DOH recommends that the next groundwater, soil gas, and indoor/outdoor air testing round occur in late summer/fall 2010 when groundwater levels will likely reach their lowest level and the smear zone in the soil is exposed.

2. The City of Montesano Planning Department should be notified within 30 days of the release of the final health consultation report that soil, soil gas, and groundwater may pose an indoor air health threat to future building occupants if new construction occurs in the area and steps are not taken to address the site contamination (e.g., installation of a soil vapor vacuum system during construction).

Public Health Action Plan

- Ecology will ensure that the health department's recommendations are fully considered in the preparation of the final approved remedial investigation report and future site work.
- Ecology will ensure that DOH receives future investigation plans and reports for the site and will consider the health department's recommendations. If there is disagreement or lack of understanding about DOH's recommendations, Ecology will meet with DOH to resolve these issues before Ecology approves the plans or reports.
- DOH will provide copies of this health consultation report to Ecology, Grays Harbor County, City of Montesano including the City of Montesano Planning Department, Whitney's Chevrolet, and three businesses located on the site (Sterling Savings Bank, Charlie's Bar, and VFW).
- DOH will post this health consultation report on its web site to make it available to the general public.
- DOH will review future investigation plans and reports that fill the data gaps if requested by Ecology.

Tables

Table 1: November 2009 Indoor /Outdoor Air Ranges of Gasoline and Non-Gasoline Components at Whitney's Chevrolet and Nearby Businesses

Chemical Name	Outdoor Air Range ($\mu\text{g}/\text{m}^3$)	Found in Nearby Soil Gas	Whitney Range ($\mu\text{g}/\text{m}^3$)	SS Bank Range ($\mu\text{g}/\text{m}^3$)	Charlie's Bar Range ($\mu\text{g}/\text{m}^3$)	VFW Range ($\mu\text{g}/\text{m}^3$)
<i>Gasoline Components</i>						
Benzene	0.47 - 1.4	Yes	5.3 - 12	0.74 - 1.6	0.8 - <0.48	2.1 -2.2
1,3-Butadiene	<0.34 - <0.36	NA	<0.33 -0.91	<0.36 - <0.37	<0.38 - <6.7	<0.73 - <1.8
n-Butylbenzene	NA	Yes	NA	NA	NA	NA
sec-Butylbenzene	NA	Yes	NA	NA	NA	NA
tert- Butylbenzene	NA	Yes	NA	NA	NA	NA
Cyclohexane	<0.52- <0.56	NA	2.9 - 3.4	1.3 - 12	4.3 - <10	<1.1 - <2.9
1,1-Dichloroethane	< 0.12 - <0.13	Unknown	<0.12 - <0.14	<0.13 - <0.14	<0.14 - <2.5	<0.26 - <0.68
Ethanol (aka ethyl alcohol)	2 - 4.1	NA	20 - 190E	45 - 610E	86 - 5600E	760E - 3900E
Ethylbenzene	<0.14 - 0.63	Yes	6.3 -16	0.45 - 0.74	0.2 - <2.6	0.36 - <0.73
4-Ethyltoluene ^a	<0.75 - <0.81	NA	3.1 - 7.6	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Ethylene Dibromide(EDB) ^b	<1.2 - <1.3	Unknown	<1.1 - <1.3	<1.3	<1.3 - <23	<2.5 - <6.4
Ethylene Dichloride(EDC) ^c	<1.2 - <1.3	Yes	0.13 - 0.16	0.27 - 0.94	<1.4 - <2.5	<0.26 - <0.68
Heptane ^d	<0.67 - 1.2	NA	16 - 35	2.4 - 18	3.8 - <12	>1.3 - <3.4
Hexane ^e	<0.57 - 0.75	NA	7.8 - 9.8	5.6 - 57	<11 - 14	2.5 - 4.1
Isopropylbenzene ^f	<0.75 - <0.81	Yes	<0.73 - <0.82	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Isopropyltoluene	NA	Yes	NA	NA	NA	NA
Naphthalenes	<4 - <4.3	Yes	0.84J - 1.6J	<4.3 - <4.4	<4.5 - <80	<8.6 - <22
2-Propanol ^g	<1.9 - 2.1	NA	7.7 - 76	9.3 - 21	<2.1 - <37	<4 - <10
n-Propylbenzene	<0.75 - <0.81	Yes	0.9 - 1.8	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Toluene	0.7 - 3.6	Yes	26 - 43	2.1 - 4	1.3 - 4.2	2.8 - 5.2
1,2,4-Trimethylbenzene	<0.75 - <0.81	Yes	3.7 - 8.7	0.81 -0.84	4.2 - 7.5	<1.6 - <4.1
1,3,5-Trimethylbenzene	<0.75 - <0.81	Yes	1.2 - 2.6	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1

Table 1: November 2009 Indoor /Outdoor Air Ranges of Gasoline and Non-Gasoline Components at Whitney's Chevrolet and Nearby Businesses

Chemical Name	Outdoor Air Range ($\mu\text{g}/\text{m}^3$)	Found in Nearby Soil Gas	Whitney Range ($\mu\text{g}/\text{m}^3$)	SS Bank Range ($\mu\text{g}/\text{m}^3$)	Charlie's Bar Range ($\mu\text{g}/\text{m}^3$)	VFW Range ($\mu\text{g}/\text{m}^3$)
2,2,4-Trimethylpentane ^k	<3.6 - <3.8	NA	<3.5 - 5.3	<0.38 - 21	<4 - <71	<7.7 - <20
m,p-Xylene	0.31 - 2	NA	20 - 53	1.4 - 2.3	0.53 - <5.3	0.8 - <1.4
o-Xylene	<0.14 - 0.72	NA	6.4 - 17	0.53 - 0.87	0.19 - <2.6	0.3 - <0.73
Total Xylenes	0.31 - 2.72	Yes	26.4 - 70	1.93 - 3.17	NA - 0.72	NA - 1.1
<i>Non-Gasoline Components</i>						
Acetone	2.7 - 8.4	NA	12.0 - 27	6.6 - 20	5.0 - 18	24 - 25
2-Butanone	0.23 - 1.5	NA	1.8 - 4.2	0.9 - 2.7	0.94 - 4.5	3.3 - 4.2
Carbon Disulfide	<2.4 - <2.6	NA	<2.6 - 2.7	<2.6	<2.7 - 47	<5.1 - <13
Chloromethane	0.82 - 0.88	No	0.9 - 1.2	0.84 - 1	0.72 - <6.3	2.2 - 2.3
1,4-Dichlorobenzene	<0.91 - <0.99	No	2.5 - 3	<0.99 - < 1	35 - 82	100 - 720
cis-1,2-Dichloroethylene	< 0.12 - <0.13	No	<0.12 - <0.13	<0.13	<0.14 - <2.4	<0.26 - <0.67
trans-1,2-Dichloroethylene	<0.6 - <0.65	No	<0.59 - <0.67	<0.65 - <0.67	<0.68 - <12	<1.3 - <3.3
Freon-11 ^h	1.1 - 1.2	NA	1.1 - 1.2	1.1	2.4 - 18	2.9 - 5.9
Freon-12 ⁱ	2.2	NA	2.1 - 2.3	2.1 - 2.2	4.1 - 32	5.1 - 10
Methylene Chloride	<1 - <1.1	Unknown	1.7 - 3	<1.1 - <1.2	2.1 - <21	<2.3 - <5.8
4-Methyl-2-Pentanone ^j	<0.62 - <0.67	NA	0.7 - 2.4	<0.67 - <0.69	<0.7 - <12	<1.3 - <3.4
Tetrachloroethylene(PCE)	<0.21 - <0.22	Yes	<0.2 - <0.23	<0.22 - <0.23	0.33 - <0.41	<0.44 - <1.1
1,1,1-Trichloroethane	<0.16 - <0.18	No	<0.16 - <0.18	<0.18 - 0.46	0.8 - <0.33	1.1 - 1.5
Trichloroethylene(TCE)	<0.16 - <0.18	No	0.54 - 15	<0.18	<0.18 - <3.3	<0.35 - <0.90
Vinyl Chloride	<0.039 - <0.042	No	<0.039 - <0.043	<0.042 - <0.043	<0.044 - <0.78	<0.084 - <0.21

$\mu\text{g}/\text{m}^3$ – micrograms per cubic meter < - less than NA - not analyzed Unknown – soil gas reporting or detection limits elevated so it could not be determined if the chemical exists in soil gas

^a 1-ethyl, 4-methylbenzene; ^b also known as 1,2-dibromethane; ^c also known as 1,2-dichloroethane; ^d also known as n-heptane;

^e also known as n-hexane; ^f also known as cumene; ^g also known as isopropanol; ^h also known as trichlorofluoromethane; ⁱ also known as dichlorodifluoromethane; ^j also known as methyl isobutyl ketone;

^k also known as iso-octane

Table 2: Contaminants in Groundwater, Soil Gas, and/or Above Background in Indoor Air at the Whitney's Chevrolet Site in 2009

Chemical Name	Found in Groundwater	Found in Soil Gas	Found in Indoor Air above Background
<i>Gasoline Related Components</i>			
Benzene	Yes	Yes	Yes
1,3-Butadiene	NA	NA	Yes
n-Butylbenzene	Yes	NA	NA
sec-Butylbenzene	Yes	NA	NA
tert- Butylbenzene	Yes	NA	NA
Cyclohexane	NA	NA	Yes
1,1-Dichloroethane	No	Unknown	No
Ethanol (aka ethyl alcohol)	NA	NA	Yes
Ethylbenzene	Yes	Yes	Yes
4-Ethyltoluene ^a	NA	NA	Yes
Ethylene Dibromide(EDB) ^b	Yes	Unknown	Yes
Ethylene Dichloride(EDC) ^c	Unknown	Yes	Yes
Heptane ^d	NA	NA	Yes
Hexane ^e	NA	NA	Yes
Isopropylbenzene ^f	Yes	Yes	Unknown
Isopropyltoluene	Yes	Yes	NA
Naphthalenes	Yes	Yes	Yes
2-Propanol ^g	NA	NA	Yes
n-Propylbenzene	Yes	Yes	Yes
Toluene	Yes	Yes	Yes
1,2,4-Trimethylbenzene	Yes	Yes	Yes
1,3,5-Trimethylbenzene	Yes	Yes	Yes
2,2,4-Trimethylpentane ^k	NA	NA	Yes
m,p-Xylene	Yes	NA	Yes
o-Xylene	Yes	NA	Yes

Table 2: Contaminants in Groundwater, Soil Gas, and/or Above Background in Indoor Air at the Whitney's Chevrolet Site in 2009

Chemical Name	Found in Groundwater	Found in Soil Gas	Found in Indoor Air above Background
Total Xylenes	Yes	Yes	Yes
<i>Non-Gasoline Related Components</i>			
Acetone	No	NA	Yes
2-Butanone	No	NA	Yes
Carbon Disulfide	No	NA	No
Chloromethane	No	No	Yes
1,4-Dichlorobenzene	No	No	Yes
cis-1,2-Dichloroethylene	Yes	No	No
trans-1,2-Dichloroethylene	Yes	No	No
Freon-11 ^h	No	NA	Yes
Freon-12 ⁱ	No	NA	Yes
Methylene Chloride	No	Unknown	Yes
4-Methyl-2-Pentanone ^j	No	NA	Yes
Tetrachloroethylene(PCE)	Yes	Yes	Yes
1,1,1-Trichloroethane	No	No	No
Trichloroethylene(TCE)	Yes	No	Yes
Vinyl Chloride	Yes	No	No

NA - Not Analyzed

Unknown – soil gas reporting or detection limits elevated so it could not be determined if the chemical exists in soil gas

^a 1-ethyl, 4-methylbenzene; ^b also known as 1,2-dibromomethane; ^c also known as 1,2-dichloroethane; ^d also known as n-heptane;

^e also known as n-hexane; ^f also known as cumene; ^g also known as isopropanol; ^h also known as trichlorofluoromethane; ⁱ also known as dichlorodifluoromethane; ^j also known as methyl isobutyl ketone; ^k also known as iso-octane

Table 3: Chemicals of Possible Inhalation Health Concern at the Whitney's Chevrolet Site in November 2009

Chemical Name	Outdoor Air Range (µg/m ³)	Screening Level (µg/m ³)	Whitney Range (µg/m ³)	SS Bank Range (µg/m ³)	Charlie's Range (µg/m ³)	VFW Range (µg/m ³)
Gasoline Components						
Benzene	0.47 - 1.4	0.1	5.3 - 12	0.74 - 1.6	0.8 - <0.48	2.1 - 2.2
1,3-Butadiene	<0.34 - <0.36	0.03	<0.33 - 0.91	<0.36 - <0.37	<0.38 - <6.7	<0.73 - <1.8
n-Butylbenzene	NA	None	NA	NA	NA	NA
sec-Butylbenzene	NA	None	NA	NA	NA	NA
tert- Butylbenzene	NA	None	NA	NA	NA	NA
Cyclohexane	<0.52- <0.56	6,300	2.9 - 3.4	1.3 - 12	4.3 - <10	<1.1 - <2.9
1,1-Dichloroethane	< 0.12 - <0.13	1.5	<0.12 - <0.14	<0.13 - <0.14	<0.14 - <2.5	<0.26 - <0.68
Ethanol (aka ethyl alcohol)	2 - 4.1	None	20 - 190E	45 - 610E	86 - 5600E	760E - 3900E
Ethylbenzene	<0.14 - 0.63	0.97	6.3 - 16	0.45 - 0.74	0.2 - <2.6	0.36 - <0.73
4-Ethyltoluene ^a	<0.75 - <0.81	None	3.1 - 7.6	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Ethylene Dibromide(EDB) ^b	<1.2 - <1.3	0.0041	<1.1 - <1.3	<1.3	<1.3 - <23	<2.5 - <6.4
Ethylene Dichloride(EDC) ^c	<1.2 - <1.3	0.04	0.13 - 0.16	0.27 - 0.94	<1.4 - <2.5	<0.26 - <0.68
Heptane ^d	<0.67 - 1.2	None	16 - 35	2.4 - 18	3.8 - <12	>1.3 - <3.4
Hexane ^e	<0.57 - 0.75	700	7.8 - 9.8	5.6 - 57	<11 - 14	2.5 - 4.1
Isopropylbenzene ^f	<0.75 - <0.81	400	<0.73 - <0.82	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Isopropyltoluene	NA	None	NA	NA	NA	NA
Naphthalenes	<4 - <4.3	0.072	0.84J - 1.6J	<4.3 - <4.4	<4.5 - <80	<8.6 - <22
2-Propanol ^g	<1.9 - 2.1	7,000	7.7 - 76	9.3 - 21	<2.1 - <37	<4 - <10
n-Propylbenzene	<0.75 - <0.81	1,000	0.9 - 1.8	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
Toluene	0.7 - 3.6	300	26 - 43	2.1 - 4	1.3 - 4.2	2.8 - 5.2
1,2,4-Trimethylbenzene	<0.75 - <0.81	7	3.7 - 8.7	0.81 - 0.84	4.2 - 7.5	<1.6 - <4.1
1,3,5-Trimethylbenzene	<0.75 - <0.81	2.7	1.2 - 2.6	<0.81 - <0.82	<0.84 - <15	<1.6 - <4.1
2,2,4-Trimethylpentane ^k	<3.6 - <3.8	None	<3.5 - 5.3	<0.38 - 21	<4 - <71	<7.7 - <20
m,p-Xylene	0.31 - 2	700	20 - 53	1.4 - 2.3	0.53 - <5.3	0.8 - <1.4

Table 3: Chemicals of Possible Inhalation Health Concern at the Whitney's Chevrolet Site in November 2009

Chemical Name	Outdoor Air Range (µg/m ³)	Screening Level (µg/m ³)	Whitney Range (µg/m ³)	SS Bank Range (µg/m ³)	Charlie's Range (µg/m ³)	VFW Range (µg/m ³)
o-Xylene	<0.14 - 0.72	700	6.4 - 17	0.53 - 0.87	0.19 - <2.6	0.3 - <0.73
Total Xylenes	0.31 - 2.72	100	26.4 - 70	1.93 - 3.17	NA - 0.72	NA - 1.1
Non-Gasoline Components						
Acetone	2.7 - 8.4	30,000	12.0 - 27	6.6 - 20	5.0 - 18	24 - 25
2-Butanone	0.23 - 1.5	5,000	1.8 - 4.2	0.9 - 2.7	0.94 - 4.5	3.3 - 4.2
Carbon Disulfide	<2.4 - <2.6	700	<2.6 - 2.7	<2.6	<2.7 - 47	<5.1 - <13
Chloromethane	0.82 - 0.88	90	0.9 - 1.2	0.84 - 1	0.72 - <6.3	2.2 - 2.3
1,4-Dichlorobenzene	<0.91 - <0.99	0.22	2.5 - 3	<0.99 - < 1	35 - 82	100 - 720
cis-1,2-Dichloroethylene	< 0.12 - <0.13	16	<0.12 - <0.13	<0.13	<0.14 - <2.4	<0.26 - <0.67
trans-1,2-Dichloroethylene	<0.6 - <0.65	800	<0.59 - <0.67	<0.65 - <0.67	<0.68 - <12	<1.3 - <3.3
Freon-11 ^h	1.1 - 1.2	700	1.1 - 1.2	1.1	2.4 - 18	2.9 - 5.9
Freon-12 ⁱ	2.2	200	2.1 - 2.3	2.1 - 2.2	4.1 - 32	5.1 - 10
Methylene Chloride	<1 - <1.1	2	1.7 - 3	<1.1 - <1.2	2.1 - <21	<2.3 - <5.8
4-Methyl-2-Pentanone ^j	<0.62 - <0.67	3000	0.7 - 2.4	<0.67 - <0.69	<0.7 - <12	<1.3 - <3.4
Tetrachloroethylene(PCE)	<0.21 - <0.22	0.41	<0.2 - <0.23	<0.22 - <0.23	0.33 - <0.41	<0.44 - <1.1
1,1,1-Trichloroethane	<0.16 - <0.18	4,000	<0.16 - <0.18	<0.18 - 0.46	0.8 - <0.33	1.1 - 1.5
Trichloroethylene(TCE)	<0.16 - <0.18	1.2	0.54 - 15	<0.18	<0.18 - <3.3	<0.35 - <0.90
Vinyl Chloride	<0.039 - <0.042	0.16	<0.039 - <0.043	<0.042 - <0.043	<0.044 - <0.78	<0.084 - <0.21

Screening Level Details – see Appendix B

Bold text - chemicals of possible inhalation health concern

results exceed screening level and outdoor air results

chemical detected but no screening level available

NA - not analyzed

None - No screening level available

E - value exceeds the instrument calibration range

µg/m³ – micrograms per cubic meter < - less than

Table 4: Comparison with Inhalation Health Threshold Levels

Chemical Name	Maximum Level (µg/m ³)	Health Threshold Level (µg/m ³)	Health Threshold Explanation	Reference
<i>Gasoline Related Components</i>				
Benzene	12	1,693	Human - NOAEL, chronic inhalation	(23)
1,3-Butadiene	<6.7	13,827	Mouse - NOAEL and CEL, chronic inhalation	(24)
Ethanol (aka ethyl alcohol)	5600E	NA	NA	
Ethylbenzene	16	217,116	Rat - LOAEL, intermediate inhalation	(25)
4-Ethyltoluene ^a <15		5,000,000	TCLo	
Ethylene Dibromide(EDB) ^b	<23	23,050	Human - NOAEL, intermediate inhalation	(26)
Ethylene Dichloride(EDC) ^c	<2.5	9,309	Mouse - NOAEL, acute inhalation	(27)
Heptane ^d	35	NA	NA	
Naphthalenes	<80	10,485	Mouse - NOAEL, acute inhalation	(28)
1,2,4-Trimethylbenzene	8.7	NA	NA	
1,3,5-Trimethylbenzene <15		NA	NA	
2,2,4-Trimethylpentane ^k <71		NA	NA	
<i>Non-Gasoline Related Components</i>				
1,4-Dichlorobenzene	720	60,123	Mouse - CEL, chronic inhalation	(29)
Methylene Chloride	<21	86,840	Rat - LOAEL; intermediate inhalation	(30)
Tetrachloroethylene(PCE)	<1.1	1,356	Human - NOAEL, chronic inhalation	(19)
Trichloroethylene(TCE)	15	161	Rats, mice - NOAEL, inhalation and route to route extrapolated	(31)
Vinyl Chloride	<0.78	12,781	Rat - CEL, chronic inhalation	(32)

µg/m³ – micrograms per cubic meter

LOAEL - lowest observed adverse effect level

CEL - cancer effect level

E - value exceeds the instrument calibration range.

NOAEL - no observed adverse effect level

TCLo = lowest published toxic dose

^a 1-ethyl, 4-methylbenzene; ^b also known as 1,2-Dibromethane; ^c also known as 1,2-Dichloroethane; ^d also known as n-heptane; ^k also known as iso-octane

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Appendix A
Components of Gasoline(18)

Table A1: Major Hydrocarbon Components of Gasoline

Fraction Compound	Gasoline Weight Percent Range	Gasoline Weight Percent Mean
C6 Aromatics		
Benzene	0.12-3.50	2.34
C3-C6 Aliphatic		
Propane	0.01-0.14	0.00666
n-Butane	3.93-4.70	3.57
Isobutane	0.12-0.37	0.316
n-Pentane	5.75-10.92	3.18
n-Hexane	0.24-3.50	2.61
2,2-Dimethylbutane	0.17-0.84	0.304
2,3-Dimethylbutane	0.59-1.55	1.41
Neopentane	0.02-0.05	
Isopentane	6.07-10.17	6.22
2-Methylpentane	2.91-3.85	3.35
3-Methylpentane	2.4 (vol)	2.14
Cyclopentane	0.19-0.58	0.131
Methylcyclopentane	not quantified	2.08
Cyclohexane		0.722
1-Pentene	0.33-0.45	0.222
1-Pentyne		
cis-2-Pentene	0.43-0.67	0.865
1-Hexene		0.22
1-Hexyne		
3-Methyl-1-butene	0.08-0.12	0.417
2-Methyl-1-Pentene	0.20-0.22	0.258
Cyclopentene	0.12-0.18	0.236
Cyclohexene	0.03	
C7-C8 Aromatics		
Toulene	2.73-21.80	8.21
Ethylbenzene	0.36-2.86	1.9
o-Xylene	0.68-2.86	2.71
m-Xylene	1.77-3.87	3.5
p-Xylene	0.77-1.58	3.5
Styrene		
C7-C8 Aliphatics		
n- Heptane	0.31-1.96	1.14
n-Octane	0.36-1.43	0.426
2,2,3-Trimethylbutane	0.01-0.04	0.025
2,2-Dimethylpentane	0.25	0.0878
2,4-Dimethylpentane	0.23-1.71	0.734
2,3-Dimethylpentane	0.32-4.17	1.54
3,3 Dimethylpentane	0.02-0.03	0.0989
2,2,4-Trimethylpentane	0.32-4.58	1.64
2,3,4-Trimethylpentane	0.11-2.80	0.519
2-Methylhexane	0.36-1.48	1.44
3-Methylhexane	0.30-1.77	1.5

Table A1: Major Hydrocarbon Components of Gasoline

Fraction Compound	Gasoline Weight Percent Range	Gasoline Weight Percent Mean
2-Methylheptane	0.48-1.05	0.614
3-Methylheptane	0.63-1.54	0.647
1,1,3- Trimethylcyclo-pentane	0.3	0.0511
1-Trans-2-trans- 4-Trimethylcyclopentane		
n-Propylcyclopentane	0.01-0.06	
1-Trans-2-dimethyl- cyclohexane		
1-Trans-4- dimethylcyclohexane		0.142
Methylcyclohexane		0.611
Trans-2-heptene	0.06-0.10	0.105
1-Octene		0.101
C9-C10 Aromatics		
1-Methyl-4-ethylbenzene	0.18-1.00	0.837
1-Methyl-2-ethylbenzene	0.19-0.56	2.89
1-Methyl-4-isopropylbenzene		
1,2,3-trimethylbenzene	0.21-0.48	0.766
1,2,4-trimethylbenzene	0.66-3.30	3.41
1,3,5-trimethylbenzene	0.13-1.15	1.14
1,2,4,5-tetramethyl-benzene	0.05-0.67	
n-Propylbenzene	0.08-0.72	0.648
Isopropylbenzene	<0.01-0.23	
n-Butylbenzene	0.04-0.44	
Isobutylbenzene	0.01-0.08	
sec-Butylbenzene	0.01-0.13	
t-Butylbenzene	0.12	
Indan	0.25-0.34	
Tetralin	0.01-0.14	
(tetrahydronaphthalene)		
Naphthalene	0.09-0.49	
C9-C10 Aliphatics		
n-Nonane	0.07-0.83	0.243
n-Decane	0.04-0.50	0.26
2,2,5-Trimethylhexane	0.17-5.89	0.177
4-Methyloctane	0.11-0.55	0.5
1,1,3-Trimethylcyclo-hexane		
Pentylcyclopentane		
1-Nonene		
1-Decene		
C11-C12 Aromatics		
n-Pentylbenzene	0.01-0.14	
n-Hexylbenzene		
Biphenyl		
Acenaphthene		

Table A1: Major Hydrocarbon Components of Gasoline

Fraction Compound	Gasoline Weight Percent Range	Gasoline Weight Percent Mean
Acenaphthylene		
1-Methylnaphthalene		
1,4-Dimethyl-naphthalene		
2,3-Dimethyl-naphthalene		
2,6-Dimethylnaphthalene		
1-Ethylnaphthalene		
2-Ethylnaphthalene		
C11-C12 Aliphatics		
n-Undecane	0.05-0.22	
n-Dodecane	0.04-0.09	
C13-C16 Aromatics		
Fluorene		
Fluoranthene		
1,4,5-Trimethylnaphthalene		
Anthracene		
9-Methyl anthracene		
Phenanthrene		
Pyrene	not quantified	
C13-C16 Aliphatics		
n-Tetradecane		
n-Hexadecane		
C17-and up Aromatics		
Benz(k)fluoranthene		
Benz(a)anthracene	not quantified	
Chrysene		
Triphenylene		
Benzo(a)pyrene	0.19-2.8 mg/kg	
Benz(e)pyrene	not quantified	
Perylene		
3-Methylcholanthrene		
Benz(ghi)perylene	not quantified	
1,2,5,6-dibenz anthracene		
C17-and up Aliphatic		
n-Octadecane		
n-Eicosane		

Source: Table taken from EA Engineering 1995, *Total Petroleum Hydrocarbon Criteria, Working Group Project #3, Based on Fate and Transport Considerations*, Prepared for Armstrong Laboratory, Brooks Air Force Base, Occupational Medicine, Brooks Air Force Base, Texas, Prepared by EA Engineering, Science, and Technology, Lafayette, California.

vol-volume, mg/kg-milligrams per kilograms

Appendix B
Health Comparison Levels

Table B-1: Health Comparison Levels

<i>Analyte</i>	<i>Cancer Class</i>	<i>Health Comparison Level ($\mu\text{g}/\text{m}^3$)</i>	<i>Reference</i>	<i>Source</i>
<i>Gasoline Related Components</i>				
Benzene	A	0.1	CREG	ATSDR (33)
1,3-Butadiene	CA	0.03	CREG	ATSDR (33)
n-Butylbenzene		No ATSDR, EPA or Ecology level		
sec-Butylbenzene		No ATSDR, EPA or Ecology level		
tert- Butylbenzene		No ATSDR, EPA or Ecology level		
Cyclohexane	IN	6,000	EPA RfCi	EPA (34)
1,1-Dichloroethane	C	1.5	Residential Air	EPA (34)
Ethanol (aka ethyl alcohol)		No ATSDR, EPA or Ecology level		
Ethylbenzene	D	0.97	Residential Air	EPA (34)
4-Ethyltoluene ^a		No ATSDR, EPA or Ecology level		
Ethylene Dibromide(EDB) ^b	LI	0.0041	Residential Air	EPA (34)
Ethylene Dichloride(EDC) ^c	B2	0.04	CREG	ATSDR (33)
Heptane ^d	D	No ATSDR, EPA or Ecology level		
Hexane ^e	IN	700	EPA RfCi	ATSDR (33)
Isopropylbenzene ^f	D	400	EPA RfCi	EPA (34)
Isopropyltoluene		No ATSDR, EPA or Ecology level		
Naphthalenes	C	0.072	Residential Air	EPA (34)
2-Propanol ^g		7,000	CA EPA RfCi	EPA (34)
n-Propylbenzene		1,000	PPRTV Appendix RfCi	EPA (34)
Toluene	IN	300	Chronic EMEG/MRL	ATSDR (33)
1,2,4-Trimethylbenzene		7	PPRTV Appendix RfCi	EPA (34)
1,3,5-Trimethylbenzene		2.7	Method B - Indoor Air	Ecology (35)
2,2,4-Trimethylpentane ^k		No ATSDR, EPA or Ecology level		
m,p-Xylene		700	CA EPA RfCi	EPA (34)
o-Xylene		700	CA EPA RfCi	EPA (34)

Total Xylenes	IN	100	EPA RfC	EPA (34)
<i>Non-Gasoline Components</i>				
Acetone	IN	30,000	Chronic EMEG/MRL	ATSDR (33)
2-Butanone	IN	5,000	EPA RfCi	EPA (34)
Carbon Disulfide		700	EPA RfCi	EPA (34)
Chloromethane	D	90	EPA RfCi	EPA (34)
1,4-Dichlorobenzene	C	0.22	Residential Air	EPA (34)
cis-1,2-Dichloroethylene	D	16	Method B - Indoor Air	Ecology (35)
trans-1,2-Dichloroethylene	D	800	Intermed & Acute EMEG	ATSDR (33)
Freon-11 ^h	D	700	HEAST RfCi	EPA (34)
Freon-12 ⁱ	D	200	HEAST RfCi	EPA (34)
Methylene Chloride	B2	2	CREG	ATSDR (33)
4-Methyl-2-Pentanone ^j	IN	3000	EPA RfC	EPA (34)
Tetrachloroethylene(PCE)		0.41	Residential Air	EPA (34)
1,1,1-Trichloroethane	D	4,000	Intermed EMEG/MRL	ATSDR (33)
Trichloroethylene(TCE)	UR	1.2	Residential Air	EPA (34)
Vinyl Chloride	A	0.16	Residential Air	EPA (34)

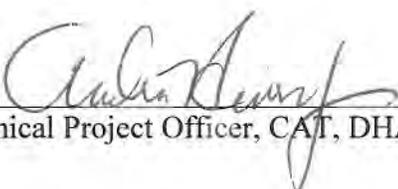
^a also known as 1-ethyl, 4-methylbenzene; ^b also known as 1,2-dibromomethane; ^c also known as 1,2-dichloroethane; ^d also known as n-heptane; ^e also known as n-hexane; ^f also known as cumene; ^g also known as isopropanol; ^h also known as trichlorofluoromethane; ⁱ also known as dichlorodifluoromethane; ^j also known as methyl isobutyl ketone; ^k also known as iso-octane.

Cancer Classes: A - human carcinogen; B1 - probable human carcinogen (limited human, sufficient animal studies); B2 - probable human carcinogen (inadequate human, sufficient animal studies); C - possible human carcinogen (no human, limited animal studies); D - not classifiable as to human carcinogenicity; E - evidence of non-carcinogenicity in humans; CA - carcinogenic to humans; LI - likely to be carcinogenic to humans; SU - suggestive evidence of carcinogenic potential; IN - inadequate information to assess carcinogenic potential; NO - not likely to be carcinogenic to humans

RfC – reference concentration RfCi – inhalation reference concentration CREG – cancer risk evaluation guideline EMEG – environmental media evaluation guideline MRL – minimal risk level PPRTV - provisional peer-reviewed toxicity values CA EPA – California Environmental Protection Agency HEAST - health effects assessment summary tables Intermed - intermediate

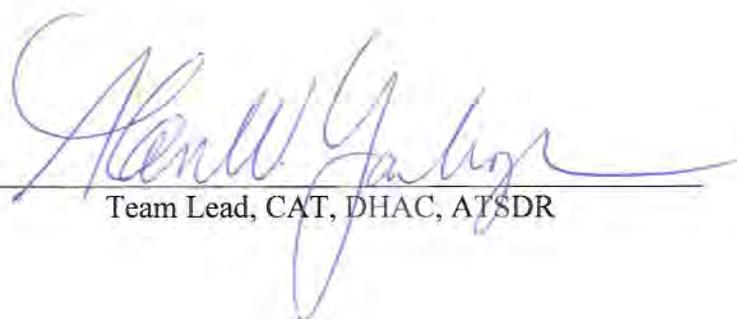
Certification

This Whitney's Chevrolet Public Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.



Technical Project Officer, CAT, DHAC, ATSDR

The ATSDR Division of Health Assessment and Consultation (DHAC) has reviewed this health consultation and concurs with the findings.



Team Lead, CAT, DHAC, ATSDR

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